

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): An air heater system for a vehicle, the system comprising:
 - an air heater having an electrothermal heating element for heating intake air flowing in an intake path of an internal combustion engine; and
 - a semiconductor switch connected to the electrothermal heating element in series for controlling energization to the electrothermal heating element,
 - the semiconductor switch being a semiconductor switch having a current detecting function provided with a terminal for current detection to detect a current which flows in the electrothermal heating element, and
 - ~~the air heater system further comprising a resistance value control means for controlling a resistance value of the electrothermal heating element to adjust the temperature of the electrothermal heating element in multiple stages based on output corresponding to the current which flows in the electrothermal heating element detected through the current detection terminal of the semiconductor switch in order to bring the temperature of the intake air to an appropriate temperature for an operating condition of the internal combustion engine~~
 - an electronic control unit receiving said current signal and controlling on-off switching of the semiconductor switch in part based on said current signal,
 - resistance value control means for controlling a resistance value of the electrothermal heating element based on output corresponding to the current which flows in the electrothermal

heating element detected through the current detection terminal of the semiconductor switch,
said electrothermal heating element heating said intake air, and
means for detecting a voltage signal across the electrothermal heating element, said
electronic control unit receiving said current and voltage signals to determine a resistance value
of the electrothermal heating element, and said electronic control unit controlling a resistance
value of the electrothermal element based on said current and voltage signals by on-off switching
of the semiconductor switch.

2. (canceled).

3. (previously presented): The air heater system for a vehicle according to claim 1, further comprising failure detection means for detecting a failure of the electrothermal heating element by detecting a resistance value of the electrothermal heating element based on output corresponding to the current which flows in the electrothermal heating element detected through the current detection terminal of the semiconductor switch.

4. (previously presented): The air heater system for a vehicle according to claim 1, wherein

the air heater includes a frame which holds the electrothermal heating element, and
the semiconductor switch is fixed to the frame.

5. (original): The air heater system for a vehicle according to claim 4, wherein
the electrothermal heating element has such a temperature converging property that a temperature rises and then converges to a predetermined convergence temperature when the electrothermal heating element is continuously supplied with maximum allowable voltage,

the frame includes a resinous part made of resin, and

the resinous part is arranged in such a place that the resinous part has rigidity adequate for actual use even when the electrothermal heating element is at the convergence temperature.

6. (original): The air heater system for a vehicle according to claim 4, wherein the electrothermal heating element has such a temperature converging property that a temperature rises and then converges to a predetermined convergence temperature when the electrothermal heating element is continuously supplied with maximum allowable voltage,

the frame includes a resinous part made of resin having a predetermined deflection temperature under load, and

the resinous part is arranged in such a place that the temperature of the resinous part remains below the deflection temperature under load even when the electrothermal heating element is at the convergence temperature.

7. (currently amended): An air heater system for a vehicle comprising:
an air heater having an electrothermal heating element for heating intake air flowing in an intake path of an internal combustion engine;

a semiconductor switch connected to the electrothermal heating element in series for controlling energization to the electrothermal heating element; and

a wiring board on which the semiconductor switch is mounted,

the air heater having a frame which holds the electrothermal heating element, and
the semiconductor switch being fixed to the frame through the wiring board, and
~~wherein the frame and the wiring board are made of resin by molding semiconductor switch and the wiring board are covered with resin so as to render the semiconductor switch and the wiring board waterproof.~~

8. (previously presented): The air heater system for a vehicle according to claim 7, wherein

the semiconductor switch has an over-temperature protecting function for interrupting current passing through the semiconductor switch when a temperature thereof becomes a shut-off temperature, and

the semiconductor switch is fixed to the frame in such a place that the temperature of the semiconductor switch becomes the shut-off temperature when the temperature of the electrothermal heating element reaches an excessive temperature.

9. (original): The air heater system for a vehicle according to claim 8, wherein
the frame of the air heater includes a metallic part, and
the semiconductor switch is fixed to the metallic part of the frame directly or through an electrical insulator.

10. (previously presented): The air heater system for a vehicle according to claim 7, wherein

the semiconductor switch includes an over-temperature signal output terminal which outputs an over-temperature warning signal when the temperature of the semiconductor switch becomes a warning temperature,

the semiconductor switch is fixed to the frame in such a place that the temperature of the semiconductor switch becomes the warning temperature when the temperature of the electrothermal heating element reaches the excessive temperature, and

the air heater system includes over-temperature protecting means for interrupting the current passing through the semiconductor switch in response to the over-temperature warning signal from the over-temperature signal outputting terminal of the semiconductor switch.

11. (original): The air heater system for a vehicle according to claim 10, wherein the frame of the air heater includes a metallic part, and

the semiconductor switch is fixed to the metallic part of the frame directly or through an electrical insulator.

12. (original): The air heater system for a vehicle according to claim 7, wherein the electrothermal heating element has such a temperature converging property that a temperature rises and then converges to a predetermined convergence temperature when the electrothermal heating element is continuously supplied with maximum allowable voltage,

the frame includes a resinous part made of resin, and

the resinous part is arranged in such a place that the resinous part has rigidity adequate for actual use even when the electrothermal heating element is at the convergence temperature.

13. (original): The air heater system for a vehicle according to claim 7, wherein the electrothermal heating element has such a temperature converging property that a temperature rises and then converges to a predetermined convergence temperature when the electrothermal heating element is continuously supplied with maximum allowable voltage,

the frame includes a resinous part made of resin having a predetermined deflection temperature under load, and

the resinous part is arranged in such a place that the temperature of the resinous part remains below the deflection temperature under load even when the electrothermal heating element is at the convergence temperature.

14. (currently amended): An air heater unit for a vehicle, the unit comprising:

an air heater includes an electrothermal heating element for heating intake air flowing in an intake path of an internal combustion engine and a frame which holds the electrothermal heating element,

a semiconductor switch fixed to the frame of the air heater and connected to the electrothermal heating element in series to control energization to the electrothermal heating element, and

a wiring board on which the semiconductor switch is mounted,

the semiconductor switch being fixed to the frame through the wiring board, and

~~wherein the frame and the wiring board are made of resin by molding~~
semiconductor switch and the wiring board are covered with resin so as to render the semiconductor switch and
the wiring board waterproof.

15. (previously presented): The air heater unit for a vehicle according to claim 14, wherein

the semiconductor switch has an over-temperature protecting function for interrupting current passing through the semiconductor switch when a temperature thereof becomes a shut-off temperature, and

the semiconductor switch is fixed to the frame in such a place that the temperature of the semiconductor switch becomes the shut-off temperature when the temperature of the electrothermal heating element reaches an excessive temperature.

16. (original): The air heater unit for a vehicle according to claim 15, wherein
the frame of the air heater includes a metallic part, and
the semiconductor switch is fixed to the metallic part of the frame directly or through an electrical insulator.

17. (previously presented): The air heater unit for a vehicle according to claim 14,
wherein

the semiconductor switch includes an over-temperature signal output terminal which outputs an over-temperature warning signal when the temperature of the semiconductor switch becomes a warning temperature, and

the semiconductor switch is fixed to the frame in such a place that the temperature of the semiconductor switch becomes the warning temperature when the temperature of the electrothermal heating element reaches the excessive temperature.

18. (original): The air heater unit for a vehicle according to claim 17, wherein
wherein the frame of the air heater includes a metallic part, and
the semiconductor switch is fixed to the metallic part of the frame directly or through an electrical insulator.

19. (original): The air heater unit for a vehicle according to claim 14, wherein
the electrothermal heating element has such a temperature converging property that a
temperature rises and then converges to a predetermined convergence temperature when the
electrothermal heating element is continuously supplied with maximum allowable voltage,

the frame includes a resinous part made of resin, and

the resinous part is arranged in such a place that the resinous part has rigidity adequate
for actual use even when the electrothermal heating element is at the convergence temperature.

20. (original): The air heater unit for a vehicle according to claim 14, wherein

the electrothermal heating element has such a temperature converging property that a
temperature rises and then converges to a predetermined convergence temperature when the
electrothermal heating element is continuously supplied with maximum allowable voltage,

the frame includes a resinous part made of resin having a predetermined deflection
temperature under load, and

the resinous part is arranged in such a place that the temperature of the resinous part
remains below the deflection temperature under load even when the electrothermal heating
element is at the convergence temperature.

21. (new): The air heater system for a vehicle according to claim 1, when said
resistance value control means controls the resistance value of the electrothermal heating element
to adjust the temperature of the electrothermal heating element in multiple stages so as to bring
the temperature of the intake air to an appropriate temperature for an operating condition of the
internal combustion engine.

22. (new): The air heater system for a vehicle according to claim 1, wherein the semiconductor switch includes:

a main body connected to the electrothermal heating element in series for controlling energization to the electrothermal heating element,

a current detection circuit which detects current passing through the main body, and

a current detection terminal outputting a current signal at a predetermined ratio to current passing through the electrothermal heating element.

23. (new): An air heater system for a vehicle, the system comprising:

an air heater having an electrothermal heating element for heating intake air flowing in an intake path of an internal combustion engine; and

a semiconductor switch connected to the electrothermal heating element in series for controlling energization to the electrothermal heating element,

the semiconductor switch being a semiconductor switch having a current detecting function provided with a terminal for current detection to detect a current which flows in the electrothermal heating element without using a heater current detecting resistor placed in series with the semiconductor switch and the electrothermal heating element for detection of the current flowing in the electrothermal heating element.